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region had the effect of greatly reducing the Moon's diameter, so that to the naked eye it looked like a planet struggling through dense haze or a nebula with ill-defined outline.* The appearance of the Moon on the two occasions was therefore utterly dissimilar, and proves that some remarkable change had occurred in the condition of our atmosphere as the medium of refracting a portion of the solar rays to the Moon when in eclipse.

When we consider that the great ring of air concerned in this refraction includes every climate existing between the poles, and that it varies rapidly in longitude owing to the Earth's rotation, it will be seen that any local or partial effects must be annihilated, and that, if our atmosphere is really the chief agent in producing dark and light eclipses, its *general* humidity must undergo surprising changes.

Bristol: February 1888.

The Total Solar Eclipse of 1889, *January* 1, *in California. Probable Meteorological Conditions at that Time.* By Edward S. Holden, LL.D., Foreign Associate, R.A.S.

(*Extract from a letter to Mr. Knobel.*)

In order to assist intending observers of this eclipse to form their programmes of observation, I have requested the authorities of the U.S. Signal Service at Washington and at San Francisco to furnish extracts from their records of cloudiness at various Californian stations near the line of total eclipse for the last fifteen days of December and the first fifteen days of January. This request has been courteously complied with, and the data available are printed in the tables which follow, as well as some others which I owe to the kindness of Major Heuer, U.S. Corps of Engineers, Inspector of Lighthouses in California. In order to draw conclusions from these tables, it is necessary to say a few words on the climate of California as affected by topographic conditions.

During the greater part of the year the ocean near the coast is covered by fogs. The coast towns, as Mendocino, Eureka, Punta Arenas, &c., thus have a high percentage of cloudiness. The coast range of mountains on its western (seaward) slope is a region of comparatively great rainfall, therefore the eastern slope of these mountains is likewise considerably affected. The interior valleys, as the valley of Clear Lake (Lake County) and the great Sacramento Valley, being protected from the prevailing western winds, are far more sunny, and this is true during the whole year. January is a particularly unfortunate time of year for astronomical work, since it falls in the middle of the wet season, when it is possible that rainy periods of a week or more may be experienced all over northern California.

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* *Monthly Notices*, vol. xlv. p. 43.

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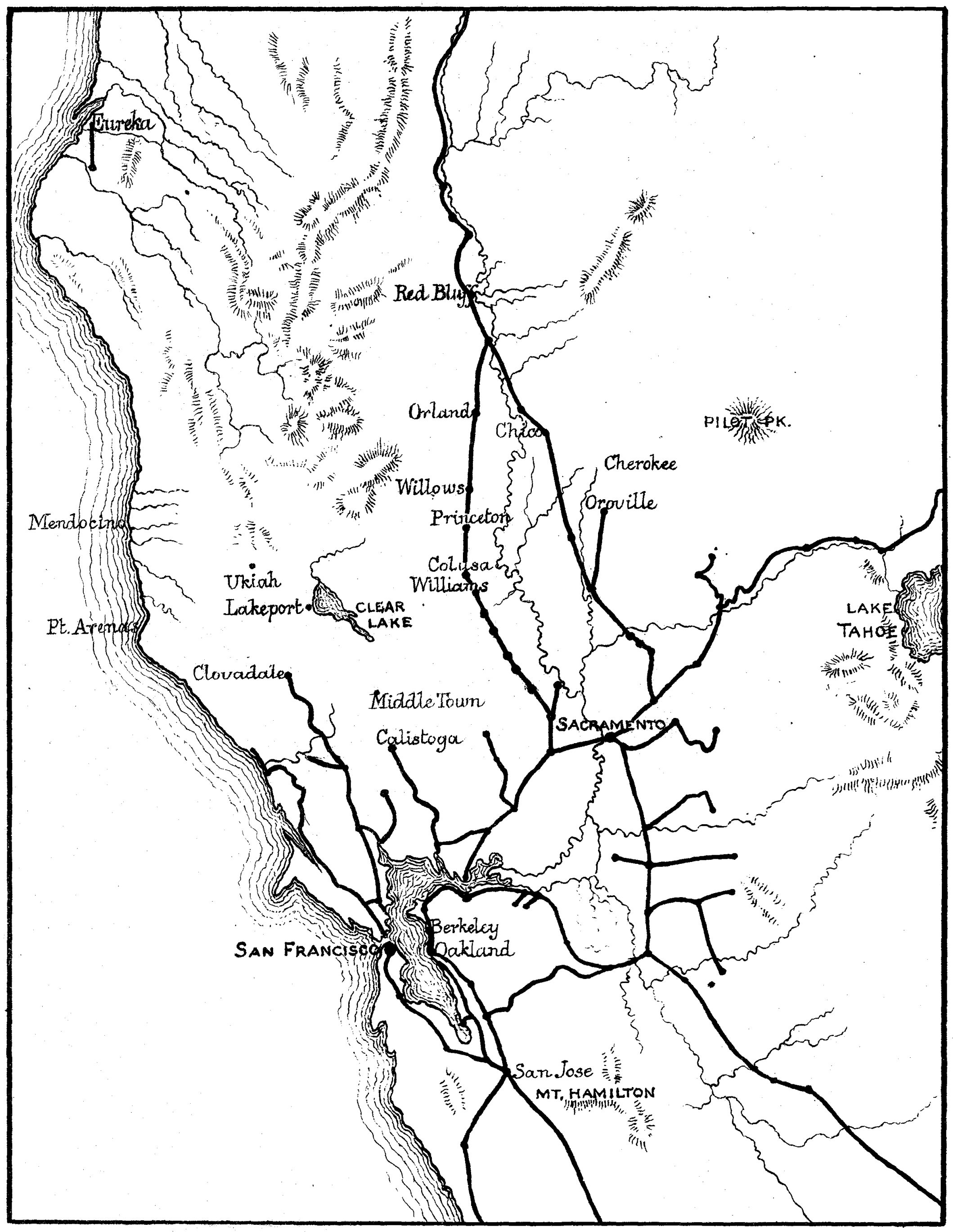

Spottiswoode & Co. Lith. London.

Railway Map of Northern California.

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At the close of the rainy season (about April), unbroken clear weather may be expected for a period of six months or more, as may be seen by referring to the meteorological records in vol. i. of the *Publications of the Lick Observatory.*

Transportation.

Railways lead from San Francisco to Cloverdale (Sonoma County), to Calistoga (Napa County), to Colusa, &c. (Colusa County), to Oroville, &c. (Butte County), as may be seen from the accompanying railway map. From the various railway stations good waggon roads lead to all points likely to be chosen for observing stations, and there will be no difficulty in procuring suitable transportation by stages or waggons, nor in finding mechanics and labourers. Punta Arenas can also be readily reached, and tolerably comfortable quarters can be secured there and at other stations.

Intending observers from England or the Continent may best bring their instruments as personal luggage by steamer to New York. At New York the boxes will have to be opened at the Custom House, and the boxes should be so fastened as to readily allow the examination. The instruments will be admitted free of duty if a special permit be obtained from the Secretary of the Treasury at Washington. No doubt Professor Newcomb, the Director of the American Ephemeris at Washington, or any of the astronomers at the Naval Observatory at Washington, would be glad to expedite free entry of such instruments, if they were communicated with by letter a month or so before leaving England. I am, of course, not authorised to speak for them, except in this general way, but I have no doubt that suitable arrangements will be promoted by them, and announced to intending observers in due time. I understand that Congress will be asked to appropriate a sum of money for the observation of this eclipse.

The instruments should be shipped *by express* from New York to San Francisco, and they will be found at Wells, Fargo & Co.'s express office in the latter city.

From San Francisco the boxes can be *expressed* to almost any point in California by the same company.

Observing Parties.

The Lick Observatory will send at least one observing party to the central line. The eclipse will also be observed by parties under the direction of Professor Davidson, of the U.S. Coast and Geodetic Survey. The permanent observatory of Professor Davidson (San Francisco), the Students' Observatory of the University of California (at Berkeley), the Chabot Observatory (at Oakland), the Lick Observatory (near San José), and various private observatories in California, will also take part in the work. No doubt a considerable number of eclipse expeditions will be formed in the Eastern States and sent to California.

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Time Signals.

Time signals sent from the Lick Observatory are received daily (at Pacific standard noon) at nearly every railway station in California. On the days immediately preceding and following the eclipse, they will be automatically transmitted from our standard clock, and special pains will be taken to make them useful to observing parties in the field.

The Positions of the Observing Stations

will, in general, have to be determined by observation, as no accurate topographical survey has been made for the interior of California. Points near the coast will have been accurately determined by the U.S. Coast and Geodetic Survey parties. Stations in the interior can usually be connected with the permanent marks of the (rectangular) surveys of the U.S. Land Office.

The Lick Observatory.

I hope that none of our foreign visitors will leave California without paying a visit to the Lick Observatory, where our corps of astronomers will be pleased to receive them. As our accommodations for guests to the mountain are quite limited, it is necessary that an appointment for the visit should be made several days in advance, and I would ask correspondence in regard to this. I regret that the opportunity for such visits falls in our most unfavourable season, but I shall hope for weather clear enough to enable some idea to be formed of our instruments and equipment. At any rate, I am sure that I can promise to all our foreign guests a magnificent mountain view, and a hearty welcome.

Meteorological Data.

The tables follow in the form in which I have received them. With a map of the region and with the explanations I have given, each intending observer can use his own judgment in the selection of a station. I have preferred not to express any definite opinion on a subject so uncertain as California weather in January, but to present the data simply.

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General Average Cloudiness for Each Day at Four California Stations, from the Records of the U.S. Signal Service.

		DECEMBER.																JANUARY.														
Stations.	Year.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Eureka, Cal.	1886–7																	00	57	47	60	100	100	47	00	70	60	93	100	67	67	57
	1887–8																	100	100	47	67	57	37	27	00	00	17	77	67	67	00	30
Cape Mendocino, Cal.	1885																	Average *daily* cloudiness, January 1885, 61·7														
	1885–6	33	83	13	17	83	80	100	100	100	100	47	40	13	37	27	53	00	37	00	17	40	43	10	50	00	17	87	100	90	87	50
	1886–7	50	67	27	40	40	100	100	33	17	87	50	87	100	67	87	40															
Red Bluff, Cal.	1885																	Average *daily* cloudiness, January 1885, 46·7														
	1885–6	100	67	00	100	100	100	67	100	100	67	37	00	00	100	47	30	00	20	00	27	00	10	00	13	00	70	70	60	67	70	70
	1886–7	87	60	47	50	40	97	97	83	60	67	100	83	100	100	100	00	27	60	00	57	30	20	00	10	00	43	87	90	100	67	57
	1887–8	7	7	00	00	00	27	7	17	30	43	47	83	100	97	80	73	100	100	7	67	40	00	23	10	00	00	00	00	30	3	33
Sacramento, Cal.	1885																	Average *daily* cloudiness, January 1885, 52·3														
	1885–6	63	100	100	100	100	87	67	93	87	67	63	00	13	00	100	23	00	00	00	00	00	00	00	00	00	00	60	33	00	00	53
	1886–7	80	13	00	17	00	60	67	67	53	80	90	23	100	100	67	00	00	33	00	30	23	00	00	00	00	00	00	33	67	67	67
	1887–8	00	00	00	00	00	13	00	00	00	43	60	43	100	100	20	7	100	100	60	30	100	47	00	00	00	00	00	33	37	00	10

Percentage of Cloudiness at Noon at Four California Stations from Records of the U.S. Signal Service.

		DECEMBER.																JANUARY.														
Stations.	Year.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Eureka, Cal.	1887																	100	50	40	100	100	100	40	00	00	80	100	100	100	100	70
	1888																	100	100	40	100	70	50	60	00	00	50	100	100	100	00	90
Cape Mendocino, Cal.	1885																	Average cloudiness *at noon*, January 1885, 6·0														
	1885–6	100	70	00	50	80	100	100	100	100	100	30	30	40	40	00	60	00	80	00	00	70	30	30	80	00	00	100	100	100	80	70
	1886–7	50	100	50	40	70	100	100	100	100	90	100	60	100	100	90	50															
Red Bluff, Cal.	1885																	Average cloudiness *at noon*, January 1885, 5·1														
	1885–6	100	100	100	100	100	100	100	100	100	100	10	00	00	100	40	10	00	60	00	80	00	00	00	40	00	00	00	80	100	100	100
	1886–7	80	80	30	80	80	100	90	80	80	100	100	90	100	100	100	40	20	80	00	80	50	10	00	30	00	30	90	70	100	100	70
	1887–8	20	20	00	00	00	60	20	10	70	80	40	100	100	90	90	100	100	100	10	100	20	00	20	00	00	00	00	00	40	00	00
Sacramento, Cal.	1885																	Average cloudiness *at noon*, January 1885, 6·0														
	1885–6	90	100	100	100	100	100	100	100	90	70	90	00	40	100	100	70	00	00	00	00	100	00	00	00	100	100	100	100	100	00	80
	1886–7	100	00	00	50	00	80	50	10	60	70	100	30	100	100	100	00	00	100	00	90	00	00	00	00	00	00	00	00	100	100	100
	1887–8	00	00	00	00	00	40	00	00	00	30	50	90	100	100	30	100	100	100	00	90	100	40	00	00	00	00	00	00	80	00	30

Fog Signal Station, Punta Arenas, Cal.

Dec. Year.	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1881	cloudy	clear	clear	clear	cloudy	cloudy	clear	clear	rain	clear	clear	rain	fog	fog	fog	clear	cloudy
1882	fog	fog	...	...	...	...	fog	fog	fog	fog	fog	...	...	...	...	...	...
1883	fog	fog	fog	fog	...	...	...	...	...	...	fog	fog	...	...	...	fog	fog
1884	...	...	fog	fog	fog	...	fog	fog	fog	...	...	...	...	...	...	...	...
1885	fog	fog	fog	fog	fog	...	...	...	...	...	...	...	...	...	...	...	...
1886	rain	rain	clear	clear	some fog	clear	clear	hazy	fog	hazy	clear	clear	rain	rain	rain	clear	fog
1887	rain	clear	clear	clear	clear	clear	clear	clear	clear	clear	hazy	rain	rain	rain	showers	showers	rain

‘Fog’ really means that there was use for the fog signal at times during the 24 hours, or for the whole day.

Fog Signal Station, Punta Arenas, Cal.

Jan. Year.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1882	cloudy	rain	cloudy	fog	fog	clear	clear	clear	clear	clear	clear	clear	clear	clear	clear
1883	...	...	...	...	...	...	fog	fog	...	fog	...	...	...	...	...
1884	...	...	fog	fog	...	...	...	...	...	...	...	...	...	...	...
1885	...	...	fog	fog	fog	fog	fog	fog	...	...	...	...	...	...	...
1886	clear	clear	clear	clear	clear	clear	clear	clear	clear	cloudy	cloudy	rain	rain	clear	rain
1887	fog	clear	clear	clear	clear	clear	clear	clear	clear	clear	clear	fog	fog	rain	clear
1888	rain	rain	clear	snow	snow	snow	clear	clear	clear	clear	clear	clear	clear	clear	rain

‘Clear’ really means that there was no necessity for the fog signal. The sky may have been somewhat overcast.

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The following statistics of the total mean monthly rainfall for a few stations near the line of totality may be of some slight moment in determining the relative value of the various places named. No really definite conclusions can be drawn from these, however, for two reasons, *first*, because the rainfall from year to year varies enormously, and *second*, because the rainfall at stations only a little distance from those named in the table may differ largely from the precipitation there set down on account of local topographical reasons.

[*From the Report of the State Engineer on Physical Data of California* (1886).]

Monthly Means of Rain and Melted Snow.

Stations.	Years.	Annual Rainfall. Inches.	Rainfall, December. Inches.	Rainfall, January. Inches.
Butte County:				
Cherokee	1871–84	43·9	6·08	8·37
Cherokee Reservoir	1873–79	60·3	5·77	13·35
Chico	1870–84	20·3	3·55	4·23
Oroville	1880–82	18·9	7·64	4·58
Colusa County:				
Colusa	1871–84	17·2	3·25	3·73
Orland	1882–84	14·7	0·47	1·95
Princeton	1873–84	14·9	2·18	3·24
Williams	1876–84	12·2	1·69	2·83
Willows	1878–84	11·5	2·31	2·09
Lake County:				
Kono Tyee, near Lakeport	1873–84	21·3	2·26	5·13
Middletown	1879–84	41·9	8·67	7·66
Mendocino County:				
Punta Arenas	1875–84	30·5	3·71	6·46
Ukiah	1876–84	32·5	4·69	7·07

Note on Mars. By Richard A. Proctor.

Mars should be carefully observed in June and July for duplication of the "canals" as Martian autumn is approached. Regarding these curious double dark streaks (or rather the bright streaks between them and the fainter streaks on either side of them), as the diffraction-images of Martian rivers at times when mist hangs over the river-beds, as I suggested four years since in the *Newcastle Weekly Chronicle*, we may expect the phenomena to be as noticeable when Martian autumn is approach-